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RESEARCH

Verena Nedon

Open Innovation in R&D Departments

An Analysis of Employees' Intention
to Exchange Knowledge in OI-Projects



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With a foreword by
Univ. Prof. Dr. Cornelius Herstatt

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Foreword

Open innovation (OI) has developed into an important branch of innovation research and relevant topic for practice. To cope with the ever-expanding complexity of R&D, companies increasingly open up their innovation processes and integrate external partners (e.g., customers, universities, suppliers) to accelerate their innovation process and/or facilitate the external use of their innovations. In- and outflows of knowledge are central to the OI-philosophy, indicating that open innovation is linked with knowledge management and especially with knowledge exchange. However, this connection is seldom addressed in the literature.

Verena Nedon bases her research on the legitimated observation that despite the wide range of possible OI-research levels, current empirical studies have a strong focus on the organizational level and most widely neglect the micro-foundation, i.e., employees engaged in open innovation. The rare studies analyzing individuals either focus on members of open source projects and other OI-communities or on lead-users. The present dissertation of Ms. Nedon is, therefore, the first study with clear emphasis on employees working for an OI-embracing company and engaging in OI-projects.

Assuming that most innovations of companies have their starting point in the R&D department, R&D employees play an important role in open innovation. By exchanging their knowledge with external partners, they lay the foundation for collaborative innovations. Consequently, to benefit from open innovation, companies need to know, which factors positively influence R&D employees' willingness and intention to exchange knowledge with external partners in OI-projects. To optimally answer this question, Ms. Nedon adopted an elaborated mixed-method approach. Her findings are based on interviews with R&D managers, a survey amongst R&D employees and follow-up group discussions with scholars and R&D managers, allowing a holistic view on the topic.

The research results linked with the competent interpretation and precise presentation confirm the chosen research approach of Ms. Nedon. Her essential contribution to research lies in the well-grounded discussion, application, and extension of the existing theory in the context of open innovation. Practitioners who are involved in setting up OI-projects receive important guidance for their activities, especially in terms of encouraging R&D employees to exchange knowledge with external partners. Therefore, Ms. Nedon's high-quality research constitutes an important contribution in theoretical as well as practical regards.

Hamburg, February 2015

Univ. Prof. Dr. Cornelius Herstatt

Acknowledgement

Innovation is the engine of every company and “[...] *distinguishes between a leader and a follower*” (Steve Jobs). To be ahead of the competition, companies grasp every opportunity to improve and accelerate their innovation processes – even the assistance of external players. The idea to not solely rely on its own resources and abilities, but to take advantage of the knowledge and brainpower of individuals outside its own boundaries is of major interest for companies as well as for researchers, who analyze this phenomenon since 2003 under the umbrella term “open innovation”. Following the OI-concept, it is impossible for a company to have all of the required expertise and suitable knowledge in-house, making knowledge exchange with external sources necessary and valuable.

Fundamentally, a company is the sum of its employees and a project the sum of individual efforts. In the case of OI-projects, the success mainly depends on the efforts of a company’s R&D employees. By exchanging their knowledge with external partners in OI-projects, they lay the foundation for open innovation. This implies, on the other hand, that their behavior can be a major risk and barrier to open innovation, e.g., if the Not-Invented-Here (NIH) syndrome hampers the acceptance of external knowledge.

Despite the fundamental role of individuals, open innovation has been analyzed mainly on the organizational level, leaving a lot of blank spots on the micro-foundation of this phenomenon. This dissertation views open innovation from the perspective of R&D employees with OI-experience and tries to make a contribution by analyzing why R&D employees engage in knowledge exchange with external partners in OI-projects. The study aims to arouse the attention of researchers as well as managers, interested in the micro-level (i.e., the people side) of open innovation.

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Munich, February 2015

Verena Nedon

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List of Abbreviations and Symbols

A	Attitude
AMOS	Analysis of Moment Structures
AVE	Average Variance Extracted
b	Standardized Path Weight/Loading (Path Coefficient)
b_i	Behavioral Belief Strength
B2B	Business-to-Business
B2C	Business-to-Consumer
c_i	Control Belief Strength
CEO	Chief Executive Officer
cf.	Compare
CFA	Confirmatory Factor Analysis
EFA	Exploratory Factor Analysis
e_i	Outcome Evaluation
e.g.	For Example
et al.	And Others
etc.	Et Cetera
f.	And the Following Page
ff.	And the Following Pages
f^2	Effect Size
H	Hypothesis
I	Intention
i.e.	That is
IIC	Inter-Item-Correlation
incl.	Including
IP	Intellectual Property
IT	Information Technology
ITC	Corrected Item-Total-Correlation
JOY	Enjoyment in Helping
KMO	Kaiser-Meyer-Olkin (Criterion)
LISREL	Linear Structural Relationships
m_i	Motivation to Comply
MAR	Missing at Random
MCAR	Missing Completely at Random
MNAR	Missing not at Random
MSA	Measure of Sampling Adequacy
N	Sample Size

n_i	Normative Belief Strength
NDA	Non-Disclosure Agreement
NIH	Not-Invented-Here
NSH	Not-Sold-Here
n.s.	Not Significant
OD	Omission Distance
OI	Open Innovation
p	p-Value
p.	Page
p_i	Control Belief Power
PBC	Perceived Behavioral Control
PLS	Partial Least Squares
pp.	Pages
q^2	Degree of Predictive Relevance
Q^2	Predictive Relevance (Stone-Geisser's Q^2)
REW	Reward
RP	Reciprocity
RQ	Research Question
R&D	Research and Development
R^2	Coefficient of Determination (Explained Variance)
SME	Small and Medium-Sized Enterprises
SN	Subjective Norm
SSL	Sum of Squared Loadings
SW	Sense of Self-Worth
TACT	Target, Action, Context, Time
TPB	Theory of Planned Behavior
TRA	Theory of Reasoned Action
VIF	Variance Inflation Factor
α	Standardized Cronbach's Alpha
λ	Standardized Indicator Loading
ρ	Composite Reliability (Goldstein-Dillon's ρ)

1 Introduction

Companies increasingly face a level of complexity and multi-disciplinarity in their research and development (R&D) of products, which a single player is unable to cope with – especially if he wants to stay competitive (see Miotti and Sachwald 2003; Pfeffer and Salancik 2009). A company can address this issue by opening up its innovation process and integrating external partners and sources (e.g., customers, universities, suppliers) to accelerate its own innovation process and/or facilitate the external use of its innovations (see Chesbrough 2003; Chesbrough et al. 2006). This phenomenon is called open innovation (OI).

"At its root, Open Innovation assumes that useful knowledge is widely distributed, and that even the most capable R&D organizations must identify, connect to, and leverage external knowledge sources as a core process in innovation." (Chesbrough 2006c, p. 2)

Consequently, relying only on its own resources and abilities is no longer a sustainable option for an innovative company (cf. Caloghirou et al. 2004, p. 31; Fichter 2005, pp. 240ff.). According to a study conducted by the Fraunhofer Institute in collaboration with Henry Chesbrough (the originator of the OI-concept), open innovation has become relevant in various industries (cf. Chesbrough and Brunswicker 2013, p. 6). The motives for engaging in OI-activities are manifold and include inter alia the access to unique knowledge, the exploration of new trends and business opportunities, the mitigation of risks, and the improvement in efficiency, leading to faster time to market (cf. Chesbrough and Brunswicker 2013, p. 18; Fichter 2005, pp. 241ff.; Wallin and Krogh 2010, p. 147). The underlying objective of a company's engagement in open innovation will affect its choice of OI-partner and how the company opens up its innovation process. According to Gassmann and Enkel (2004), a decision can be taken to opt for outside-in OI (i.e., to obtain external knowledge and integrate it in the internal innovation process), or inside-out OI (i.e., the exploitation of internal ideas and technologies outside the company), or a coupled OI-approach (i.e., the combination of outside-in and inside-out activities). Each approach offers different configuration possibilities, so that companies can choose between various options to engage in open innovation (cf. Chesbrough and Brunswicker 2013, p. 10): They can, for instance, enter R&D alliances with different partners, engage in customer co-creation, and/or use crowdsourcing (outside-in OI). They could also set up a spin-off, out-license their IP, and/or enter a joint-venture (inside-out OI). This diversity gives ample scope for the configuration of an individual and company-specific OI-roadmap. To optimally exploit this great potential, most companies adopting open innovation decide for a coupled OI-approach (see Lichtenthaler 2008; Schroll and Mild 2011; Vrande et al. 2009).

1.1 Research Motivation and Objective

Open innovation has not only become a relevant topic for companies, but also for researchers. During the last decade, open innovation has gradually developed into a broad research field with many different streams and various connections to other research areas.¹ The resulting span of OI-research means there are still a lot of blank spaces, even though numerous scholars have already made their contribution to this field.

The inflows and outflows of knowledge are central to the OI-definition (see Chesbrough 2006c), indicating that open innovation is associated with the management of knowledge and especially with the exchange of knowledge. However, this connection is seldom addressed in the literature. Notwithstanding this shortfall, a major gap in OI-research results from the unbalanced examination of different examination objects. Despite the wide range of possible OI-research levels (cf. Vanhaverbeke and Cloudt 2006, pp. 276ff.); current studies have a clear emphasis on the organizational level (cf. West et al. 2006, p. 287). Very few studies focus on individuals (cf. Vrande et al. 2010, p. 226) and employees' perspectives on open innovation are the most widely neglected. The rare studies dealing with open innovation in connection with employees examine OI-relevant competencies and characteristics (see Enkel 2010; Du Chatenier et al. 2010; Pedrosa et al. 2013) or discuss possible individual-related OI-barriers (cf. Enkel 2009, pp. 189ff.), which can be subdivided into three stereotypes: "want-barrier", "shall-barrier", and "can-barrier". Recognizing this imbalance and the fact that a micro-foundation is essential for reliable explanations on a more aggregated level (see Coleman 1990; Felin and Foss 2005), scholars have tried to encourage other researchers to focus more on the level of the individual (cf. Elmquist et al. 2009, pp. 339ff.; Vanhaverbeke 2006, pp. 206f.; Vanhaverbeke and Cloudt 2006, p. 279; Vrande et al. 2010, p. 230; West et al. 2006, pp. 287ff.).

"[U]nderstanding the fundamental cogs and wheels of what happens in organizations requires beginning from their fundamental constituents, namely individuals [...]." (Foss et al. 2010, p. 457)

Employees deserve special attention because they are the ultimate decision-makers in an organization – even though they do not act in a social "vacuum" (cf. Husted and Michailova 2010, p. 40).

"[K]nowledge resides within [...] the employees who create, recognize, archive, access, and apply knowledge in carrying out their tasks. Consequently, the movement of knowledge across individual and organizational boundaries, into and from repositories, and into organizational routines and practices is ultimately dependent on employees' knowledge-sharing behaviors." (Bock et al. 2005, p. 88)

¹ For an overview of existing OI-literature, see Dahlander and Gann 2010; Elmquist et al. 2009; Gassmann 2006; Gassmann et al. 2010; Lichtenthaler 2011; Vrande et al. 2010.

Assuming that the R&D department of a company is the place where most companies' innovations begin, R&D employees play an important role in open innovation and so were selected as the object of this study. By exchanging their knowledge with external partners in OI-projects, R&D employees lay the foundation for collaborative innovation. However, this also implies their behavior can be a major risk to open innovation, e.g., if the Not-Invented-Here (NIH) syndrome (see Clagett 1967, Katz and Allen 1982) hampers the acceptance of external knowledge.

"Of course, organizational barriers to user solution data do not necessarily end even after the information enters the firm. A firm's R & D group, for example, may well regard such information with a dubious eye. And, given typical incentives and staffing patterns such a reaction, too, is perfectly logical. Note that R & D groups are often staffed with people who are trained to develop new products and processes in-house and are rewarded for this task." (Hippel 1988, p. 119)

Consequently, companies following an OI-approach do not only depend on co-operation from external partners, but particularly on the support of their R&D employees. To benefit from the OI-approach, companies therefore need to understand their R&D employees' motives for exchanging knowledge in OI-projects. However, very little is known about open innovation at the level of employees and especially about determinants of their knowledge exchange behavior in OI-projects. Therefore, the main objective of my study is to understand why R&D employees become active in OI-projects and why they participate in knowledge exchange with external partners in OI-projects, respectively. Furthermore, I will strive to identify basic conditions facilitating this exchange and to derive implications for companies.

1.2 Research Approach and Contribution

Guided by the aspiration to shed light on the reasoning behind R&D employees' participation in OI-projects in the form of their knowledge exchange with external partners, I have formulated three research questions. To answer them, I have searched the literature for suitable theories that would provide a proper theoretical foundation for my research. In the course of this search, I realized that the three stereotypes of OI-barriers ("want", "shall", "can") influencing individuals' behavior can be related to the theory of planned behavior (TPB). The TPB assumes individuals' intention to behave in a certain manner is determined by three factors: their attitude toward the behavior (associated with "want-barrier"), the subjective norm, or perceived social pressure to perform or not perform the behavior (associated with "shall-barrier"), and the perceived behavioral control (associated with "can-barrier") (see Ajzen 1991). Since the knowledge exchange behavior of individuals had not yet been researched in the context of open innovation, a literature review of publications connecting the TPB and individuals' knowledge exchange behavior was conducted. The goal was to identify motivational factors and related theories that have an impact on employees'

willingness to exchange knowledge in OI-projects. Based on the TPB and this literature review, I derived a research model and related hypothesis.

To answer the three research questions optimally, I decided to combine qualitative and quantitative methods (cf. DeCuir-Gunby 2008, pp. 125f.; Walliman 2006, pp. 36f.) and acquired four companies willing to participate in my study. The companies all publicly pronounced the application of open innovation and were manufacturers with global business, headquartered in Germany, and operating in the fields of chemistry, automation, and steel treatment. As a first step, I conducted interviews with 12 OI-experienced R&D managers to understand the R&D perspective on open innovation. Secondly, I initiated an online survey among OI-experienced R&D employees. By means of the resulting 133 usable responses, the research model and related hypotheses could be tested. Lastly, three follow-up group discussions helped to interpret the results from the survey. The application of this empirical mixed method approach allowed me to develop the survey with the help of the interviews; to confirm results from the different methods; and to elaborate and clarify results of the online survey with results from the interviews and group-discussions (cf. Greene et al. 1989, p. 259).

To date, very few empirical studies have connected open innovation with knowledge exchange, examined open innovation in an R&D context, or focused on the personnel's views on open innovation. Furthermore, to my knowledge no study has ever combined these aspects. My thesis is the first empirical study with a clear focus on OI-experienced R&D employees and on the determinants of their intention to exchange knowledge with external partners in OI-projects. The thesis targets a set of relevant questions related to the human side of open innovation and thereby applies the TPB for the first time in an OI-context. It challenges the prior dominant position of the organizational level in OI-studies and, thus, significantly contributes to the micro-foundation of OI-research and to the current understanding of open innovation. The findings give critical insights into open innovation at the level of R&D employees. In detail, I can show that the surveyed R&D employees' attitude is not the dominant determinant of their intention to exchange knowledge with external partners in OI-projects. Instead, the perceived social pressure to exchange knowledge in OI-projects has by far the most powerful impact. The study also reveals the importance of differentiating between the exchange of documented and undocumented knowledge in the context of open innovation. Furthermore, the results show that most of the motivational factors derived from the knowledge management literature help to explain employees' attitude toward their knowledge exchange in OI-projects and that the surveyed R&D employees are mainly intrinsically motivated. Organizational rewards do not have a significant influence on their attitude, but rewards connected to their personal development play a role. This implies that it is worthwhile having a closer look at the reward construct in the context of knowledge exchange in OI-projects and to distinguish among different kinds

of rewards. Lastly, my study uncovers that – from an R&D employee's perspective – the most important requirements for participating in knowledge exchange with external partners are related to legal security, a trustful relationship with the external partner, and common ground and fairness between the parties.

The findings of my thesis are not only relevant to the research community that can relate to my results, but also for OI-experienced companies and OI-newcomers. The results indicate how to leverage R&D employees' intention to exchange their knowledge in OI-projects. Furthermore, companies can use the results to reconsider their incentive systems and to reflect if, and to what extent, the general framework of their OI-projects meets the requirements for knowledge exchange in OI-projects.

1.3 Structure of Dissertation

This thesis is structured into eight chapters, with this introduction being *chapter 1*.

In *chapter 2*, the underlying concepts of this study are outlined and research questions are framed, based on the identified research gap. Since the OI-approach is the fundamental concept of this study, antecedents and basic principles are introduced and an overview of prior and current research streams related to open innovation is provided. Furthermore, the link between open innovation and knowledge management is emphasized and OI-relevant aspects of knowledge management are discussed. Finally, a research gap is identified and three research questions are derived, which lay the foundation for the thesis.

Chapter 3 introduces the theories consulted to derive the hypotheses for the empirical part of this study and to answer the formulated research questions. The theory of planned behavior builds the theoretical foundation of this study and is discussed in detail. A literature review about publications connecting the TPB and individuals' knowledge exchange behavior is presented and motivational factors that impact on employees' willingness to exchange knowledge in OI-projects are identified. Based on the TPB and the literature review, hypotheses are derived and a research model is composed.

In *chapter 4*, the research approach of this thesis is explained and the process of company selection for the empirical part of my study is outlined. In addition, details on the qualitative pre-study (interviews) and the quantitative main study (online survey) are provided. In particular, the development and pre-test of the questionnaire, the data collection procedures, and the data analysis methods are explained.

Chapter 5 summarizes the findings from interviews conducted with R&D managers and reveals their perspectives on open innovation. The typical procedure of setting up an OI-project and selecting an OI-partner is outlined and basic conditions for an OI-project are expounded. Furthermore, open innovation is assessed based on the identified advantages and disadvantages.

In *chapter 6*, the findings from the online survey are summarized. After discussing the data distribution and bias treatment, sample characteristics and some other interesting descriptive findings are highlighted. The results from an open-ended question regarding OI-requirements are then presented. Lastly, the measurement model and the structural model are evaluated.

Chapter 7 discusses findings from the interviews and online survey with regard to the three research questions. The findings are compared with and related to prior research to take a holistic view on the research questions and to answer them. Further, the literature is consulted to find possible explanatory approaches for hypotheses that were not supported by the data.

In *chapter 8*, the findings of my study are considered with regard to their contribution to academic research. Furthermore, managerial implications are derived. Lastly, the limitations of the study are highlighted and recommendations for further research are formulated.